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The Newark System or Red Sandstone Belt (of New Jersey). By HENRY B. KÜMMEL. Annual Report of the State Geologist of New Jersey for 1897, pp. 25-159. Trenton, N. J.

In the corresponding report for 1896 Dr. Kümmel presented a brief report on the Newark system of the western part of New Jersey. He has now extended his work so as to cover the whole of the area of the system within the state, and the present report embodies the results of his fuller studies. As indicated in an earlier number of this JOURNAL, Dr. Kümmel finds the Newark system divisible into three series, the basis for subdivision being lithological, not palæontological. These divisions, commencing below, are (1) the Stockton series, the characteristic beds of which are arkose sandstones and conglomerates; (2) the Lockatong series, the characteristic beds of which are black shales, dark, massive argillites, and gray and green flagstones; and (3) the Brunswick series, consisting primarily of red shale and sandstone. Maps are presented showing the distribution of these several divisions. As a result of the profound faults affecting the western part of the system, the several series do not appear at the surface in single, continuous belts, but are repeated. The disposition of the outcrops is still further complicated by the folding which the beds of the system have suffered. In the eastern part of the state the Lockatong series does not appear, but the Stockton series is found in limited areas on both sides of the Palisade ridge.

One of the interesting facies of the system is the conglomerate which occurs along its northwest border, at and near its junction with the pre-Mesozoic terranes. This conglomeratic phase of the system assumes different aspects at different points. It is now made up chiefly of limestone, now of gneiss; and now of quartzite; but the significant point in the relations of these several phases of conglomerate is the fact that the larger areas of calcareous and quartzite conglomerates do not abut against older formations of limestone and quartzite, but against gneiss instead. The conglomerates are clearly shore deposits, and it is therefore inferred that the conglomerate beds were not derived chiefly from the older formations against which they now lie. It is believed that faulting along the contact of the Triassic system with the older formations is responsible for the lack of correspondence between most of the conglomerates and the formations against which they abut.

Another point of interest and significance is found in the fact that the conglomerates do not occupy a distinct horizon, but that each of the three series in turn becomes conglomeratic as the border of the system is approached. Incidentally it may be inferred that the north-western extension of the system was never much greater than now, since the shore phase of each series is represented along the present border.

The relations of the igneous rocks of the system also receive much more systematic discussion than in any previous publication. Several small areas of igneous rocks (dikes) heretofore unmapped have been located. While the previous conclusions as to the intrusive character of some of the trap sheets and the extrusive character of others are confirmed, the evidence on which these conclusions rest is so fully detailed, and is in itself so decisive, that further discussion of this point is not likely to arise.

Many of the principal structural features of the Newark system have long been known, but no previous student of these formations has worked out the details of the structure with anything like the fullness shown by the present report. The general monoclinical structure of the system (strike N. 30° to 50° E, and dip 13° or 15° to the north-west) is found to be affected by several broad, gentle flexures, and by a few sharply marked folds, especially in the vicinity of the intrusive sheets of trap and along the greater fault lines. The positions of these flexures are given and their effects on the topography, where beds of unequal resistance outcrop, are pointed out. Even among the gentle folds of the system the axes of flexure sometimes depart from horizontality because of still gentler cross-folds, showing that the forces which deformed the beds were not confined to one direction.

The beds of the Triassic system have long been known to be faulted, but not until now have these faults been worked out in detail. Of the two major faults, one (the Flemington fault) was known before Dr. Kimmel's studies began, while the other (the Hopewell fault) was discovered by him. Both these faults have a throw of several thousand feet, and each causes the repetition of the outcrop of each of the three series of the system. Besides these two principal faults, displacements are believed to exist along the northwest border of the system at more than one point.

Of minor faults there are many. Something like fifty are described, and many figures are given showing in a graphic way the evidence on

which their existence is known. The throw of these minor faults varies from a few feet to several hundred. The faults enumerated are more frequent in the trap than in the shale and sandstone. Since faults are much more easily detected where they affect the trap, owing to the fact that this formation has come to assume the form of ridges since the faulting, it is inferred that minor faults affecting the more homogeneous portions of the sedimentary part of the system may have escaped observation.

But for the faults, the determination of the thickness of the system would be an easy matter. Allowance can be made for the faults which are known, but there is no way of taking quantitative account of those which have not been discovered. Impressed with the fact that there may be many undiscovered faults of slight extent in the homogeneous shales and sandstones, Dr. Kümmel has revised his estimate of the thickness of the system, and now gives the following figures :

Brunswick series, - - - - -	6,000 to 8,000
Lokatong series, - - - - -	3,500 to 3,600
Stockton series, - - - - -	2,300 to 3,100
	11,800 to 14,700

The thicknesses of the principal sheets of trap are also given, the thickest being less than one thousand feet. A brief discussion of the conditions of the origin of the system is followed by a résumé of its economic resources.

The report, as a whole, presents in excellent form the results of a piece of work which is not likely to need revision. It is a matter of congratulation that Dr. Kümmel has this year been able to extend his studies over the Triassic area of New York.

R. D. S.

The Geological History of the Isthmus of Panama and Portions of Costa Rica. By ROBERT T. HILL, Bulletin of the Museum of Comparative Zoölogy at Harvard College, Vol. XXVIII, No. 5, pp. 151-285. Nineteen plates. Cambridge, 1898.

The results embodied in this report are based on a reconnaissance made by the author for Alexander Agassiz in 1895. In spite of the fact that the region concerned was only reconnoitered, the report adds